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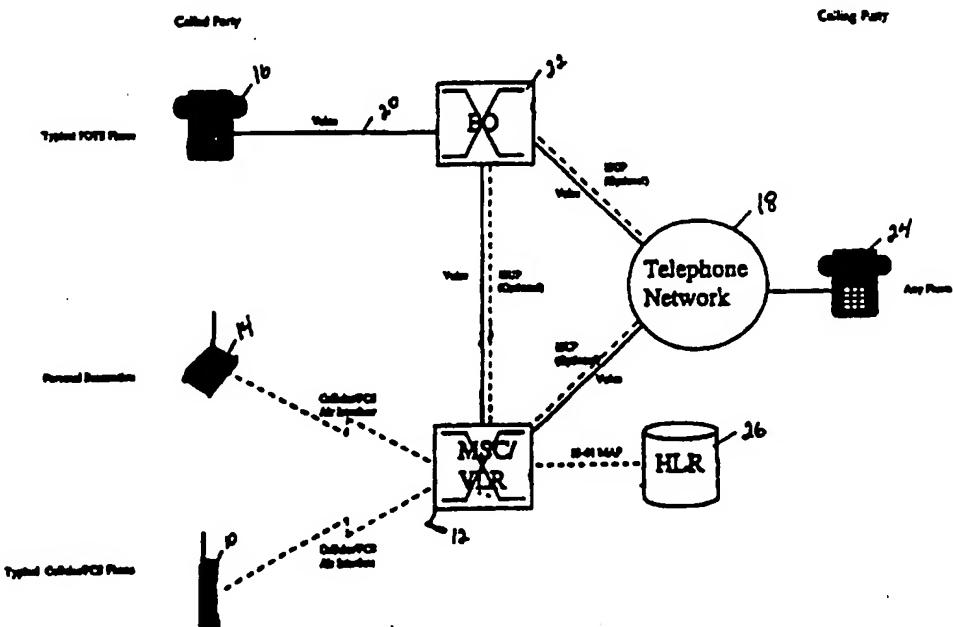
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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## (54) Title: INTEGRATED CELLULAR AND WIRELINE TELEPHONE SERVICE



## (57) Abstract

An integrated cellular and wired lined telephone system includes a mobile cellular network (12) coupled to a public switched telephone network (18).

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## INTEGRATED CELLULAR AND WIRELINE TELEPHONE SERVICE

### BACKGROUND OF THE INVENTION

#### Field of the Invention

This invention relates to communication systems.

More particularly, the invention relates to systems and methods for integrated portable cellular and wired line telephone service.

#### Background Discussion

Mobile cellular and personal communication system (PCS) devices allow users to place or receive telephone calls at any point throughout a wireless telephone network. A cellular/PCS device is convenient when the user is mobile, since it accesses a telephone network using a wireless link. However, a call made or received on a cellular/PCS device is much more expensive than a call on a wired line network due, in part at least, to the high costs required for installing, operating and maintaining an air link for the cellular/PCS device. To lower the costs of cellular/PCS service, one industry proposal is to have a subscriber personal base station, for example, a cordless phone receiver, originate a call to a

cellular/PCS network, notifying the network to route all cellular calls to a subscriber's wired line phone number when the subscriber's cellular/PCS device is within range of or docked in the base station. The originated call from the base station goes to a new network element at a mobile switching center that answers the call, collects the necessary information, emulates a visitors location register (VLR) and originates a registration notification to a subscriber's home location register (HLR). When registered, the call will result in the HLR querying the new network element or special VLR for re-routing information on all subsequent calls made to the subscriber's cellular number. The special VLR will respond to the HLR by re-routing such subsequent calls to the subscriber's wired line phone number. However, such special VLRs result in higher network costs for equipment and maintenance and further result in more signalling overhead for cellular/PCS networks. Accordingly, there is a need to further improve integrated cellular and wired lined telephone service to eliminate special equipment and accompanying additional signalling thereby enabling subscribers to effect savings in the costs of air time for calls made to a subscriber's cellular/PCS device number while the subscriber is at home.

## SUMMARY OF THE INVENTION

The present invention satisfies the need previously described in a cellular/PCS network. The invention includes a Mobile Switching Center (MSC) coupled to a public switched telephone network (PSTN). Each cellular/PCS device in the network cooperates with a personal base station at the subscriber location. The personal base station has the facility to detect the presence of the cellular/PCS device within a selected range. When a cellular/PCS device is within the selected range of or docked in the personal base station a message is sent by the base station over an airlink to the MSC and on to the HLR. The message causes the MSC under the direction of the HLR to forward the subscriber's incoming cellular call to his plain old telephone service (POTS)/wired line service instead of to his cellular device thereby saving airtime. A home location register (HLR) in the PSTN serving the mobile switching center for the cellular/PCS device is modified to have a new type of call forwarding protocol. The new call forwarding protocol is activated only when the subscriber's cellular/PCS device is within range of or docked in the personal base station. In this case, all calls to the cellular/PCS device are routed to the subscriber's wired lined phone number. Several

alternate methods are provided for notifying the HLR of the need to activate the new "subscriber home" call forwarding method. A first method involves the personal base station originating a signalling message to the HLR indicating that the subscriber's cellular/PCS device is at the home location. A second method involves the subscriber's cellular/PCS device originating a signalling message to the HLR indicating that it is within range of the personal base station and thus home.

In the foregoing methods, the "subscriber home" call forwarding for his wired line phone would be deactivated upon a receipt of a registration notification from the subscriber's cellular/PCS device.

#### BRIEF DESCRIPTION OF THE DRAWING

The invention will be better understood from the following description of preferred embodiments taken in conjunction with the accompanying drawing, in which:

Figure 1 is a block diagram of an integrated cellular and wired line telephone system incorporating the principles of the present invention.

**Figure 2 is a flow diagram of a cellular registration in the cellular network of Figure 1.**

**Figure 3 is a flow diagram of a personal base station registration in the cellular network of Figure 1.**

**Figure 4 is a flow diagram of a cellular call termination in the cellular network of Figure 1.**

**Figure 5 is a flow diagram of a personal base station call termination in the cellular network of Figure 1.**

**Figure 6 is a flow diagram of a personal base station de-registration in the cellular network of Figure 1.**

#### **DESCRIPTION OF THE PREFERRED EMBODIMENT**

**In Figure 1, a conventional cellular/PCS device 10 which is part of a mobile cellular network including a plurality of devices 10 (not shown)**

is coupled to a mobile switching center (MSC) 12. The mobile device 10 is operated by a subscriber having a home location or office which includes a personal base station 14 coupled over an airlink to the MSC and a standard wiredline telephone 16 coupled through a wire line 20 and an end office 22 to a public switched telephone network (PSTN) 18. The end office is a typical end office providing user with wiredline plain old telephone service (POTS) to the telephone 16. Also coupled to the network 18 is any calling phone 24 which may be wireless or wired line, able to originate a phone call to a cellular/PCS subscriber.

The personal base station 14 detects the presence of the cellular/PCS device 10 when within a selected range or docked in the base station 14. The base station 14 includes a conventional proximity device and an interface to communicate over an airlink to the MSC to which the cellular/PCS device is assigned. Any message originated by the base station includes a source address of the base station and a destination address of a home location register (HLR) 26. The base station triggers a message to initiate call forwarding of the subscribers incoming mobile calls to his POTS wired line service when the subscriber

cellular/PCS device is within range of or docked in the base station. The base station also includes a message to the HLR assigned to the cellular/PCS device to turn off call forwarding of cellular calls when the device is not within the range of or docked in the base station. Also included in the base station is a light or signal (not shown) to indicate that call forwarding is or is not re-directing calls from the cellular/PCS device to the POTS phone. The base station may also include an on/off switch (not shown) to override the proximity detection device.

The MSC 12 includes a visitor location register (VLR). Both the MSC and the VLR are typical components used in a cellular/PCS mobile network. To this effect, the VLR includes a program stored in a memory (not shown) to recognize messages sent by each base station indicating whether call forwarding should be activated or deactivated for the cellular/PCS device assigned to such base station. In response to such message, the VLR identifies the address or phone number for directing calls to the cellular/PCS device or to the POTS phone, as the case may be.

A home location register (HLR) 26 coupled to the MSC/VLR manages the correlation between the phone 10 and the base station 14 in initiating or terminating the transfer of a mobile call between the phone 10 and the phone 16. The HLR records in a data base (not shown) the address or phone number to which calls should be directed to for a subscriber's cellular/PCS device or his POTS phone, according to the message received from the VLR.

Turning to Figure 2, a typical cellular phone registration with the MSC is shown. This call flow would be used for all registration by the subscriber's cellular/PCS device. In an operation 201, a subscriber initiates the cellular/PCS device registration with the HLR. The procedure can be initiated when the subscriber powers on the phone; originates a call; changes the MSC/VLR serving location as well as other actions. In an operation 203, the cellular/PCS device sends a message to the MSC/VLR serving the phone. In an operation 205, the MSC/VLR sends a message to the HLR indicating the location of the cellular/PCS device and the call forwarding number serving the phone.

The phone number for the cellular/PCS device is the default condition.

In an operation 207, the HLR records the location and the call forwarding number of the cellular/PCS device in the HLR database.

Turning to Figure 3, the personal base station registration process is shown. This registration procedure results from the subscriber's phone being within range of or docked in the base station 14. In an operation 301, the base station 14 detects the cellular/PCS device's radio signal or the presence of the device docked in the personal base station.

In an operation 303, the personal base station initiates the registration procedure after the detection of the presence of the cellular/PCS device. In response to such actions, the base station outputs a message to the VLR containing a source address for the base station; a destination address for the HLR assigned to the base station and an identification number for call forwarding subscriber cellular call to a POTS phone.

In an operation 305, the MSC/VLR notifies the HLR of the cellular/PCS registration and the call forwarding number. In operation 307, the HLR recognizes the change in registration and transfers any call to the cellular/PCS device to the subscriber's wired line phone.

In Figure 4, a typical cellular call termination procedure is shown for a cellular/PCS call. This call flow would be used when the subscriber is not within the range of the personal base station.

In an operation 401, a call is originated from any phone to the subscriber's cellular/PCS device number.

In an operation 403, the call traverses the necessary telephone networks to the MSC/VLR associated with the subscriber's home MSC.

In an operation 405, the MSC/VLR queries the HLR for the location and treatment for handling the call. In this instance the

subscriber is being served by the same MSC that is the subscriber's home MSC.

In an operation 407, the HLR indicates to the MSC that the call is to be completed to the cellular/PCS device since the device is not within the range of or docked in the base station.

In an operation 409, the MSC completes the call to the cellular/PCS device.

In Figure 5, a basestation call termination process is shown when the subscriber is within range of or docked in the personal base station. In this case, the resulting call is forwarded to the subscriber's wired line service and not to the cellular/PCS device. In an operation 501, a call is originated from any phone to the subscriber's cellular/PCS device number.

In an operation 503, the call traverses the necessary telephone network to the MSC/VLR associated with the subscriber's home MSC and initiates call processing.

In an operation 505, the MSC/VLR queries the HLR for call handling information. In this instance, the HLR will have detected the registration of the personal base station, as described in Figure 3. As a result, the HLR will determine that the call is to be forwarded to the subscriber's wired line service.

In an operation 507, the HLR indicates to the MSC that the call is to be forwarded to the subscriber's local POTS phone.

In an operation 509, the MSC forwards the call to the end office providing the subscriber local service. It should be noted that there will not necessarily be direct trunking between the MSC and the end office.

In an operation 511, the end office completes the call to the subscriber's POTS phone.

In Figure 6, the call flow is shown for basestation deregistration after a selected time interval when the subscriber's cellular/PCS device is no longer in range of the personal base station. In this case, cellular calls are directed to the subscriber's cellular/PCS device.

In an operation 601, the base station detects that the cellular/PCS device is no longer within its range either by the loss of the radio signal or the removal of the cellular/PCS device from the docking station.

In an operation 603, the base station after a selected time interval initiates de-registration from the network, i.e., a simulated power down. A message is sent by the base station through the MSC/VLR indicating the de-registration condition of the base station.

In an operation 605, the MSC/VLR forwards the de-registration to the HLR.

In an operation 607, the HLR updates the subscriber profile and restore incoming calls to the cellular/PCS device.

In summary, an integrated cellular and wired lined telephone system has been described in which cellular calls are forwarded to a wired lined phone at a subscriber location when a cellular/PCS device assigned to such subscriber location, is within the range of, or docked in a base station located at such subscriber location. When the cellular/PCS device is not within the range of or docked in the base station, a second message from the base station to the MSC causes the call forwarding address stored in the HLR to forward calls to the cellular/PCS device. The system lowers the use and cost of air time by a cellular/PCS device which makes such service more attractive to the general public. Further, the improvement is achieved with few modifications to a conventional mobile cellular telephone system.

While the present invention has been described with respect to specific embodiments, the description is illustrative of the invention and is not to be construed as limiting the invention. Various modifications

may occur to those skilled in the art without departing from the spirit and the scope of the invention.

CLAIMS

What is claimed is:

1. An integrated cellular and wireline telephone system comprising:
  - a) a mobile cellular network comprising a plurality of cellular/personal communication system (PCS) devices;
  - b) a personal base station and a plain old telephone service (POTS) phone served by a wired line installed at a subscriber location to which a cellular/PCS device is assigned;
  - c) means for processing a call initiated by any telephone to the cellular/PCS device;
  - d) means included in the personal base station for detecting the presence of a radio field associated with the cellular/PCS device; and
  - e) means for notifying the processing means to forward all calls to the POTS phone instead of the cellular/PCS device when the cellular/PCS device is within the radio range of or docked in the personal base station.

2. The integrated cellular and wired line telephone system of claim 1 wherein the personal base station initiates a message from the base station to the system when the cellular/PCS device is not within the range of or docked in the base station.
3. The integrated cellular and wired line telephone system of claim 1 further comprising a home location register for providing the phone number to direct calls to the cellular/PCS device when the cellular PCS device is within the range of or docked in the personal base station.
4. The integrated cellular and wired line telephone system of claim 3 further comprising means for initiating a message from the personal base station using an air link to the means for processing calls, the message including a message source address; a message destination address and an address or phone number for the system to direct calls to the cellular/PCS device.

5. The integrated cellular and wired lined telephone system of claim 4 wherein the means for processing a call includes a visitor location register for receiving messages from the personal base station and notifying the home location register of the address or location to direct calls for the cellular/PCS device assigned to the base station.

6. The integrated cellular and wired lined telephone system of claim 5 wherein the VLR notifies the HLR the status of the cellular/PCS device relative to the personal base station when the device is not within the range of or docked in the base station.

7. In an integrated cellular and wired lined telephone system, a method for transferring calls to a wired line phone when such call is directed to a cellular/PCS device which is within the range of or docked in a personal base station coupled to the system comprising the steps of:

- a) initiating through the system a call from any telephone to a cellular/PCS device;
- b) detecting the presence of the cellular/PCS device when within the range of or docked in the personal base station;

- c) initiating a message to the system including a mobile switching center and public switched telephone network when the cellular/PCS device is within the range of or docked in the personal base station;
- d) notifying a home location register included in the system of a call forwarding number when a message is received by the system from the base station; and
- e) providing the call forwarding address to the system to redirect the call to the cellular/PCS device to a wired lined phone located at a subscriber location to which the cellular/PCS device is assigned.

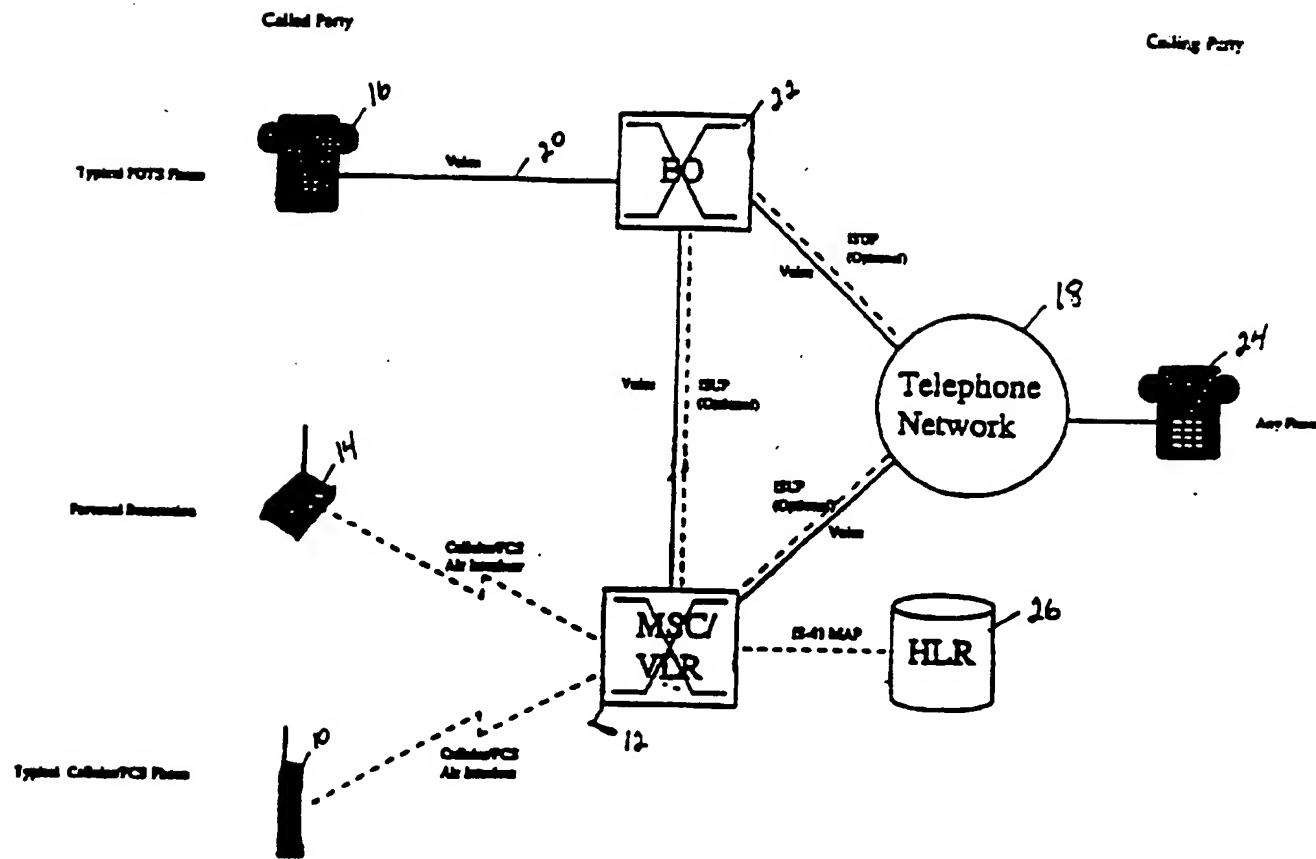
8. The method of claim 7 further comprising the steps of generating a second message from the personal base station to the system when the cellular/PCS device is not within the range of or docked in the personal base station; and

changing the call forwarding address in the home location register to the phone number for the cellular/PCS device when the second message is received by the home location register.

9. The method of claim 8 further comprising the step of generating a message by the personal base station when the cellular/PCS device is not within the range of or docked in the base station.
10. The method of claim 9 further comprising the step of a visitor location register (VLR) in the system querying the HLR for location and call treatment handling a call directed to the cellular/PCS device.

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FIGURE 1  
INTEGRATED CELLULAR WIRED LINE SYSTEM



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## CELLULAR PHONE REGISTRATION

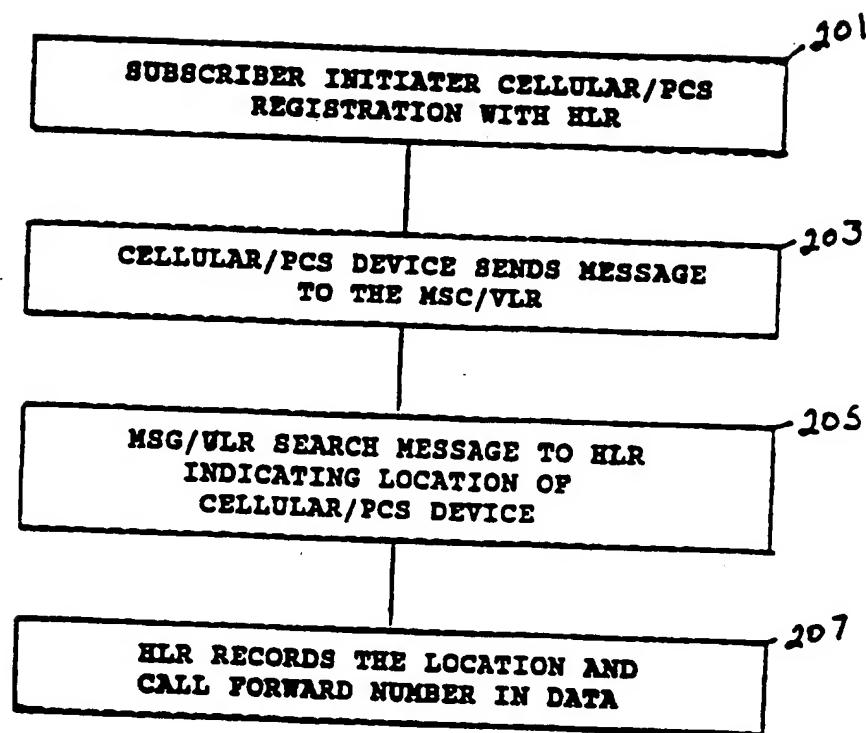
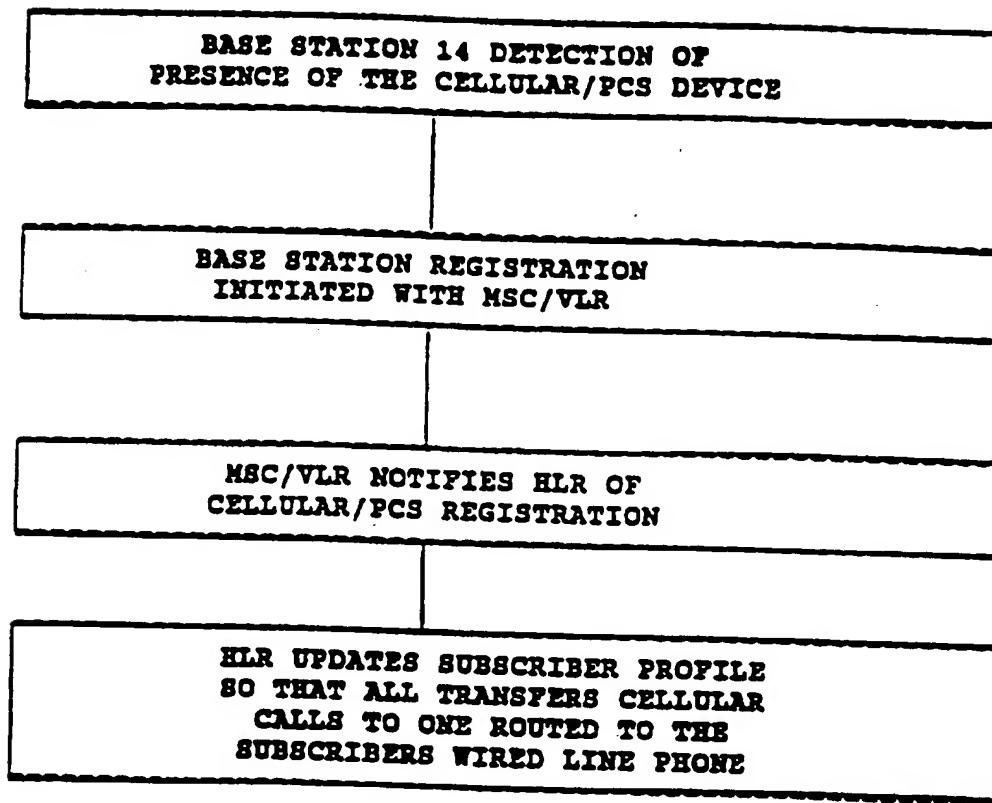


FIGURE 2

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**BASE STATION REGISTRATION****FIGURE 3**

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## CELLULAR CALL TERMINATION

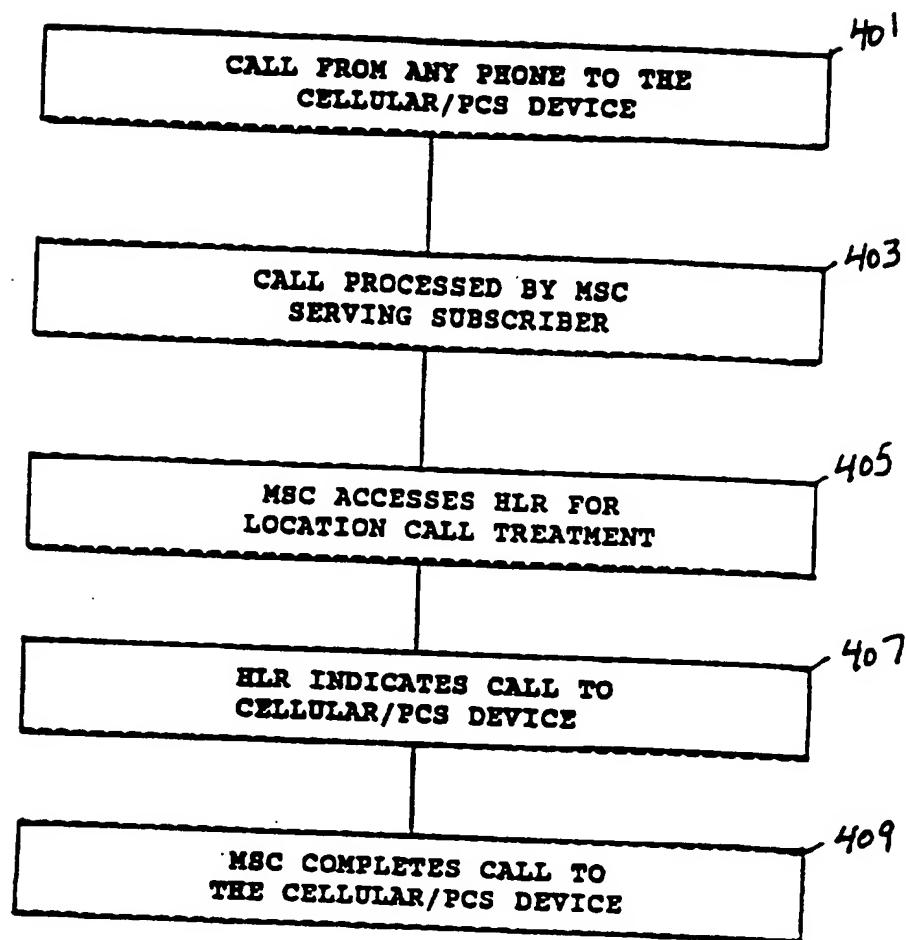


FIGURE 4

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## BASESTATION CALL TERMINATION

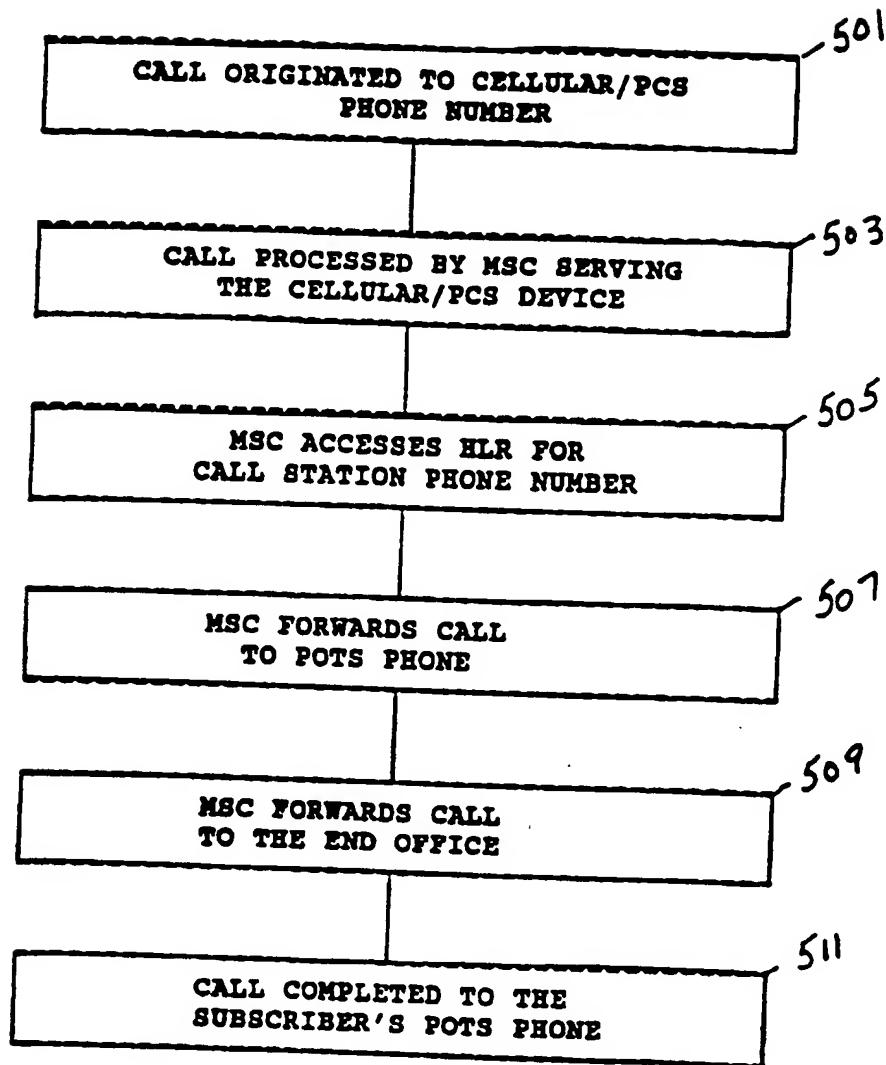


FIGURE 5

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## BASESTATION DEREGRISTRATION

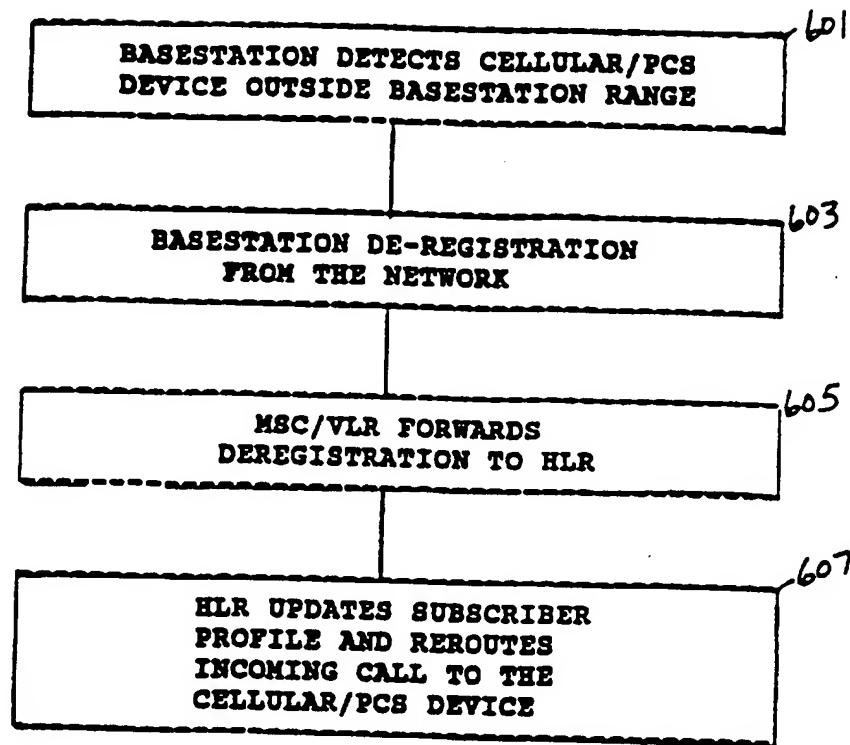


FIGURE 6

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US96/19879

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :H04Q 7/22  
US CL :379/59

According to International Patent Classification (IPC) or to both national classification and DPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 379/59, 58

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

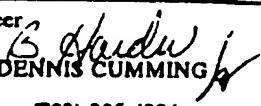
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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages      | Relevant to claim No. |
|-----------|---|-----------------------|
| Y         | US, A, 4,284,848 (FROST) 18 August 1981, column 1, lines 44-60.                         | 1-10                  |
| Y         | US, A, 5,353,331 (EMERY ET AL) 04 October 1994, column 7, line 55 to column 9, line 44. | 1-10                  |
| Y, P      | US, A, 5,577,103 (FOTI) 19 November 1996, column 2, lines 52-62.                        | 1-10                  |
| A, P      | MEYERS, "Wireless Nation", Telephony, March 4, 1996                                     | 1-10                  |
| A, P      | ALLEVEN, "Potential Investors Lured By Demo", Wireless Week, June 24, 1996              | 1-10                  |

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**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/US96/19879

**B. FIELDS SEARCHED**

Electronic data bases consulted (Name of data base and where practicable terms used):

APS search terms: telephone network, personal communication system, telephone system, personal communication network, phone network, mobile telephone, phone system, pcs, cellular telephone, base station, radio telephone, central station, location, cordless telephone, fixed station, call initiated, wireless telephone, parent station, forward, master station, processing a call, hlr, direct call, vlr, docked, transferring call wire telephone

